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(54) ELECTRIC MOTOR

ELEKTROMOTOR

MOTEUR ELECTRIQUE

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ing of three winding strips from Fig. 2, in perspective view, and

Fig. 5 shows a cut-out section from the curved winding demonstrating its absolute roundness.

Fig. 1a shows in cross-section a spindle motor 1a which is used in particular as a drive motor for hard disks in data processing appliances. A motor shaft 2 of this spindle motor 1a is fixedly connected to a plate 3 of a hard disk housing (not shown). Two hydrodynamic axial bearings 5a and 5b support a hub 6 around the motor shaft 2 in the shaft portion remote from the plate 3. A further hydrodynamic spiral bearing 4 is present close to a support plate 8. The hub 6 journalled on the motor shaft 2 with rotation possibility has an inner hub portion 6a which surrounds the motor shaft 2 and on whose outside 6b is fastened a permanent magnetic rotor magnet 7. The field generated by the rotor magnet 7 and present at its outside 7a is perpendicular to the axis of rotation 16. A support plate 8 is arranged on the motor shaft 2. This plate carries on its outside a coil configuration 9 which belongs to the motor stator and which is yet to be described below, and a yoke 10 which is also to be described below. The hub 6 further comprises an outer hub portion 6c which with its bell shape surrounds the yoke 10.

The coil configuration 9 comprises a bent foil winding which is described further below. The support plate 8 in this motor construction supports the jacket-type yoke 10 of soft magnetic material on the outside 9a of the coil configuration 9. In this construction, two air gaps 11 and 12 are formed, of which the one air gap 11 separates the yoke 10 from the hub 6 and the other air gap 12 separates the rotor magnet 7 from the coil configuration 9.

Fig. 1b shows in cross-section a spindle motor 1b in a modified arrangement. The spindle motor of Fig. 2 corresponds to the spindle motor 1a of Fig. 1 in many respects. Corresponding parts have been given the same reference numerals. The motor shaft 2 of the spindle motor 1b of Fig. 2 is fixedly connected to the plate 3 of the hard disk housing (not shown). Two hydrodynamic axial bearings 5a and 5b support the hub 6 at the portion of the motor shaft 2 remote from the plate 3. A further hydrodynamic spiral bearing 4 is present close to a support plate 8. A permanent magnetic rotor magnet 7 is fastened on the hub 6.

The support plate 8 is provided at the motor shaft 2 and supports the coil configuration 9 which consists of a bent foil winding and will be described further below. The outside 9a of the coil configuration 9 adjoins an air gap 13. The air gap 13 is bounded on the outside by a jacket-type yoke 10 of soft magnetic material. This yoke 10 is fixedly arranged at the inside 14 of the hub 6, which also has a jacket shape. In this construction, accordingly, there are again two air gaps: the air gaps 12 and 13, of which the one air gap 13 separates the yoke 10 from the coil configuration 9 and the other air gap 12 separates the rotor magnet 7 from the coil configuration 9.

The outer hub portion 6c provides space for the mounting of one or several hard disks.

Fig. 2 shows in plan view three foil windings 20, 21, 22. These three foils are to be rolled so as to form a three-phase winding for the hard disk motor. The rolled state is shown in perspective view in Fig. 4. Each single foil comprises, as Fig. 3 shows, a central synthetic resin foil 23 on whose two surfaces 23a and 23b copper foils 24 and 25 have been provided. The copper foils 24 and 25 were so etched in a generally known etching treatment that gaps 26 are created which separate individual copper conductor tracks 27 from one another, as is visible in Fig. 3. Planar coil windings 28 were thus formed on the foil 23 on both sides, which serve for motor excitation. The coils of the two foil sides are electrically interconnected from the upper to the lower side.

In a silk-screen printing or roller coating process, the gaps 26 are filled up with an adhesive filler material. The adhesive filler material is a polymerizing glue. The glue has the property that it connects the planar conductor track portions 29a, 29b, 29c, 29d, 29e, 29f in a manner so stable that the planar conductor tracks 29 of the coil are interconnected again thereby with a dimensional stability as if the gaps 26 were still filled with the removed copper. Without etching, the copper would have allowed itself to be shaped into a perfectly round shape in the continuous state. Thanks to the filling of the gaps 26 with the adhesive filler glue, this is again achieved. Fig. 4 shows in perspective view how the three foil windings 20, 21, 22 are rolled up into a three-phase winding in a perfectly round shape. For a clearer view, Fig. 5 shows a cross-section in which the perfect curvatures of the foils 20, 21 and 22 are shown even better.

The perfect curvature renders it possible to keep the air gap of the motor small. Furthermore, a very good radial support is achieved by the construction of the hydrodynamic spiral groove bearings 4, 5a and 5b. The perfectly wound winding and the use of the spiral groove bearings minimize the radial bearing forces generated by the motor, and thus the deviation of the rotor axis. The result of this is that the motor has a longer life and/or allows for wider manufacturing tolerances. A higher packing density of the hard storage disks is furthermore facilitated thereby.

To give a general idea of the dimensions, the foil between the copper tracks has a thickness of approximately 20 µm, and the copper foils are provided to a thickness of approximately 110 µm.

Claims

1. An electric motor with a stationary and a movable active motor part, one of the two active motor parts comprising a motor winding and the other a motor magnet, an air gap being formed between said ac-

tive motor parts, while the motor winding (9) is built up on a synthetic resin carrier foil and is formed through local removal of copper material with which the synthetic resin foil (23) had previously been fully coated, characterized in that

- the synthetic resin carrier foil (23) and the planar coils (28) adhering thereto are provided with an adhesive filler material (30) such that the adhesive filler material (30) fills up gaps (26) formed between the individual conductor tracks through the removal of the copper material, and
- the assembly thus stabilized is wound into an evenly rounded cylinder.

2. An electric motor as claimed in Claim 1, characterized in that the adhesive filler material (30) filling the gaps has a stability such that the planar conductor tracks (27) of the coils (28) are interconnected thereby again with a dimensional stability as if said gaps (26) were still filled with the removed copper.

3. An electric motor as claimed in Claim 2, characterized in that the adhesive filler material (30) at the same time also covers the upper surfaces of the planar coils (28) with a layer.

4. An electric motor as claimed in Claim 2, characterized in that a polymerizing glue is used as the adhesive filler material.

5. An electric motor as claimed in one or several of the Claims 2 to 4, characterized in that the adhesive filler material is provided by means of silk-screen printing or roller coating.

6. Hard disk drive provided with an electric motor according to any of the claims 1 to 5.

Patentansprüche

1. Elektromotor mit einem ortsfesten und einem beweglichen aktiven Motorteil, wobei einer der beiden aktiven Motorteile eine Motorwicklung aufweist und der andere Teil einen Motormagneten, wobei zwischen den genannten aktiven Motorteilen ein Luftspalt gebildet ist, während die Motorwicklung (9) auf einer Kunststoffträgerfolie aufgebaut ist und durch örtliche Entfernung von Kupfermaterial, mit dem die Kunststoffträgerfolie (23) vorher völlig bedeckt war, gebildet wird, dadurch gekennzeichnet, daß

   - die Kunststoffträgerfolie (23) und die zugehörigen Flachspulen (28) mit einem Haftfüllmaterial (30) versehen werden, so daß das Haftfüllmaterial (30) zwischen den einzelnen Leiterspuren durch die Entfernung der Kupfermaterials gebildete Spalte (26) füllt, und
   - das auf diese Weise stabilisierte Gebilde in einem gleichmäßig gerundeten Zylinder gewickelt wird.

2. Elektromotor nach Anspruch 1, dadurch gekennzeichnet, daß der die Spalte ausfüllende Haftfüllstoff (30) eine solche Stabilität hat, daß die flächenhaften Leitungszüge (27) der Spulen (28) durch ihn so formstabil miteinander verbunden werden, als wären die Spalte (26) noch mit dem abgetragenen Kupfer gefüllt.

3. Elektromotor nach Anspruch 2, dadurch gekennzeichnet, daß das Haftfüllmaterial (30) auch die oberen Flächen der Flachspulen (28) mit einer Schicht bedeckt.

4. Elektromotor nach Anspruch 2, dadurch gekennzeichnet, daß ein polymerisierender Kleber als Haftfüllmaterial verwendet wird.

5. Elektromotor nach einem oder mehreren der vorstehenden Ansprüche 2 bis 4, dadurch gekennzeichnet, daß das Haftfüllmaterial im Siebdruck- oder Roller-Coating-Verfahren aufgetragen wird.

6. Festplattenantrieb mit einem Elektromotor nach einem der Ansprüche 1 bis 5.

Revendications

1. Moteur électrique avec une partie de moteur stationnaire et une partie de moteur active mobile, l'une des deux parties de moteur actives comprenant un enroulement de moteur et l'autre un aimant de moteur, un entrefer étant formé entre lesdites parties de moteur actives tandis que l'enroulement de moteur (9) est constitué sur une feuille de support en résine synthétique et est formé par l'enlèvement local de la matière de cuivre par laquelle la feuille de résine synthétique (23) a été préalablement entièrement revêtue, caractérisé en ce que :

   - la feuille de support en résine synthétique (23) et les bobines planes (28) qui y adhèrent sont dotées d'une matière de charge adhésive (30) telle que la matière de charge adhésive (30) remplit les intervalles (26) formés entre les pistes conductrices individuelles par l'enlèvement de la matière de cuivre, et
   - l'ensemble ainsi stabilisé est enroulé en un cylindre uniformément rond.

2. Moteur électrique selon la revendication 1, caractérisé en ce que la matière de charge adhésive (30)

remplissant les intervalles a une stabilité telle que les pistes conductrices planes (27) des bobines (28) sont en l'occurrence interconnectées avec une stabilité dimensionnelle comme si lesdits intervalles (26) étaient encore remplis du cuivre enlevé.

3. Moteur électrique selon la revendication 2, caractérisé en ce que la matière de charge adhésive (30) recouvre aussi en une couche les surfaces supérieures des bobines planes (28) simultanément.

4. Moteur électrique selon la revendication 2, caractérisé en ce que la colle polymérisante est utilisée comme matière de charge adhésive.

5. Moteur électrique selon l'une ou plusieurs des revendications 2 à 4, caractérisé en ce que la matière de charge adhésive est appliquée par sérigraphie ou revêtement par rouleau.

6. Entraînement de disque dur doté d'un moteur électrique conformément à l'une des revendications 1 à 5.

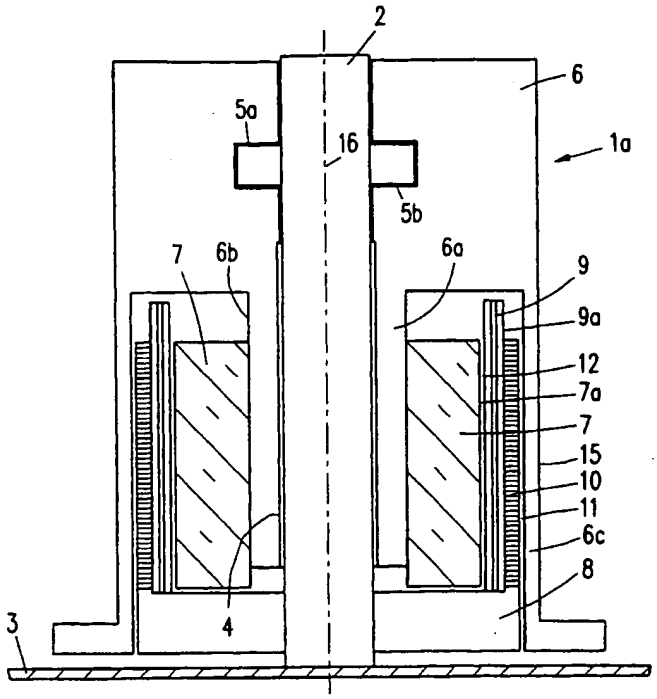

FIG. 1a

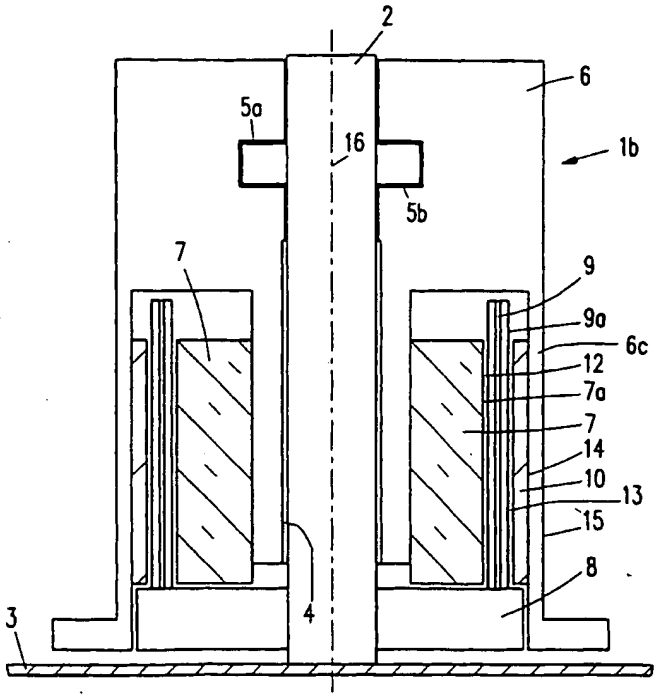

FIG. 1b

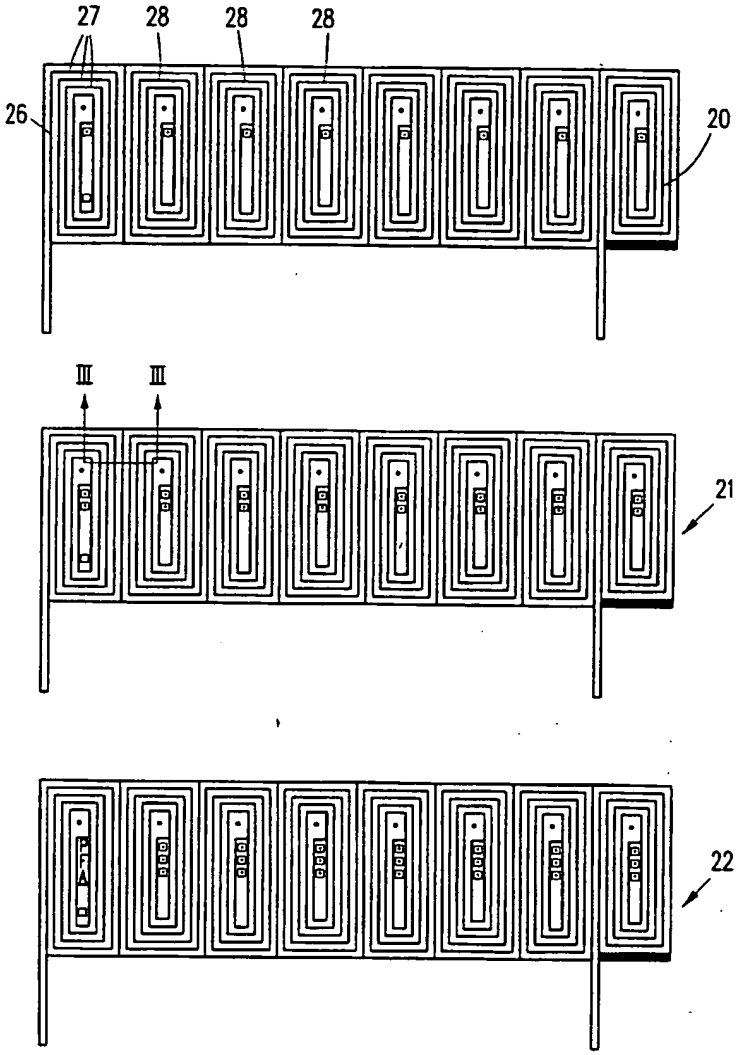

FIG. 2

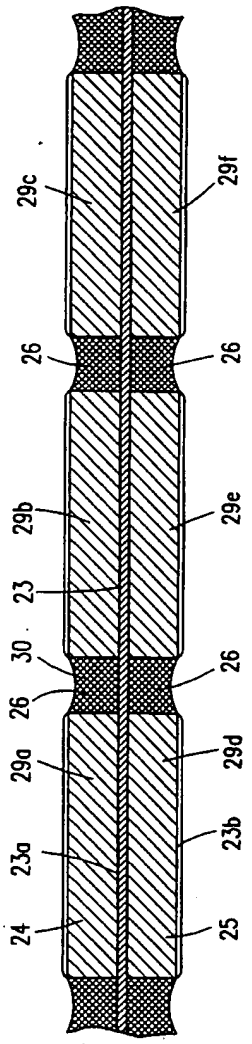

FIG. 3

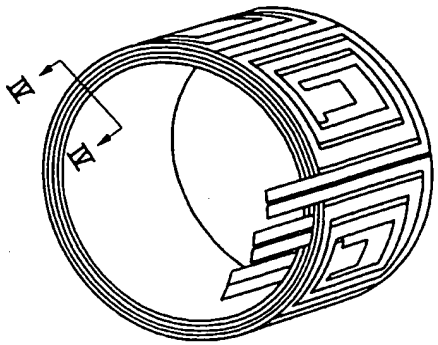

FIG. 4

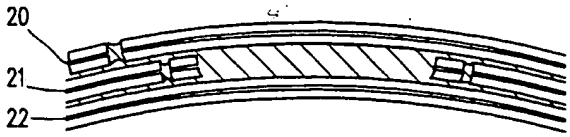

FIG. 5